Integration and Technological Capability Accumulation In International Joint Venture in China

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1. Introduction

This study examines how Chinese state-owned enterprises (SOEs) have accessed the global resources of multinational corporations (MNCs) by forming international joint ventures (IJVs), thus improving their technological capability.

The study focuses on the benefit of foreign direct investment (FDI) at the firm level. Looking into the way businesses acquire institutional knowledge, the study examines whether IJVs have built local technological capability through acquiring and then using the international resources and knowledge of the foreign joint venture partners, and if so, the level of the technological capability that they have been able to develop as a result. This study also examines how the technological capability is accumulated, by studying integration mechanisms of the joint venture, in particular, the joint venture's relationship with its foreign parent, and with the foreign parent's affiliates. In this way I identify the mechanisms IJVs employ to build local technological capability and the determinants of the rate at which they are able to build such capability.

Following the framework for evaluating technology at the operational level developed by Bell and Pavitt (1995) and Lall (1992) (see Table 2-1), the study examines the determinants of technology building at given levels of development and the different processes by which firms may advance to higher levels of technological competence
The data reported in this study was collected from IJVs engaged in manufacturing, by means of a survey questionnaire (see Appendix 1). The survey was administered through the questionnaire and by face-to-face follow-up interviews of IJV managers in the cities of Beijing and Shanghai, and the provinces of Jiangsu, Tianjin and Zhejiang.

It is hoped that this study will advance the international business community's understanding in two areas. While much literature has focused on how MNCs build their technological capability to compete in mature economic markets, this paper explores instead how joint ventures can exploit those resources to improve the competence of businesses operating in a newly developing economic market.

The second contribution of this study is to track the evolution of technology building by analyzing the organizational issues of the international joint venture. By using IJVs as the analytical setting, the study can compare different processes of joint ventures and determine how those differences affect a firm's ability to successfully accumulate technological capability.

2. Theoretical Framework

This section discusses theoretical issues related to technological capability accumulation, paying attention to the current literature related to that subject. Section 2.1 examines the structure of the international joint venture, Section 2.2 looks at technology and learning,

Section 2.3 reviews the literature related to technological capability, and Section 2.4 discusses possible determinants of technological capability development in China in the context of IJVs, proposing hypothetically the linkage between four such determinants and technological capability accumulation.

2.1 International Joint Ventures

Joint ventures are arrangements where a new, separate entity is created by the combination of the resources of two or more parent companies (Inkpen & Beamish, 1997). The joint ventures in this study are the product of firms from different countries cooperating across national and cultural boundaries (Yan & Luo, 2001). My study focuses on foreign firms going into business with a local Chinese partner. For many years this was practically the only method by which foreign companies could invest in China. The investment regulations pertaining to equity contribution and control of the joint venture have heavily favored the local Chinese partners. The Chinese government has been keen to ensure that too much control does not reside in the hands of foreign investors (even though it was also keen to attract foreign money).

The joint venture partnership is an arrangement at the strategic level. It has two dimensions, one is interdependence, and the other is reciprocity. Joint ventures represent reciprocal exchanges among partner firms that cannot be explained as market-based, arm's length exchanges (Das & Teng, 2002). They typically involve the exchange of an important asset, usually knowledge/learning, and technology or market access. A joint venture partnership can be one of the quickest and most cost-effective ways to grow a business, or it can be used as a defensive measure to counteract business initiatives of competitors.

From the MNC's perspective, a joint venture can achieve at least seven overlapping objectives: risk reduction, economies of scale and/or rationalization, technology exchanges, co-opting or blocking competition, overcoming government-mandated trade or investment barriers, facilitating initial international expansion of inexperienced firms, and vertical quasi-integration advantages of linking the complementary contributions of the partners in a "value chain" (Contractor & Lorange, 1988).

The primary motive for Chinese companies to form joint ventures with foreign companies is to access the unique organizational management skills and capabilities of the foreign entities (Luo, 2001), and to generate exports and gain technology transfers (Rosen, 1999). As China opened its door to the outside world, Chinese businesses came to realize the importance of a firm's organizational structure and management capabilities in gaining competitive advantage in the domestic Chinese marketplace. Chinese companies engage in joint ventures to exploit the value of a foreign partner's resources. Collaborations with foreign companies are a useful vehicle for enhancing functional knowledge in critical areas where the desired level of knowledge is lacking and "cannot be developed within an acceptable timeframe or cost" (Madhok, 1997, Das & Teng 2002). As Chinese companies were making the transition from a planned economy to a market economy, joint ventures became preferred whenever "the critical inputs required to pursue the opportunity are owned by different parties and when these inputs are

inseparable from other assets of the owner firms" (Ramanathan et al, 1997, Das & Teng 2002). Collaboration with foreign companies offers the chance to learn foreign management skills as well as technology.

Therefore, "organizational learning" is a viable goal and rationale for joint venture formation.

In the current research, I focus on joint ventures in the manufacturing sector because the effects of learning on value creation are stronger for the research and production joint venture and weaker for the marketing joint venture (Anand & Khanna, 2000). As globalization increases, many cross-border joint ventures are created by domestic partners intending to access knowledge, skills, and resources that cannot be internally produced in a timely or cost-effective fashion (Yan & Luo, 2001). Empirical studies have found that "equity" joint ventures are more effective in transmitting learning than are "contract-based" alliances, such as those arising through licensing agreements (Mowery, Oxley & Silverman, 1996, Shenkar & Li, 1999). The joint venture is the organizational form that is most likely to produce a natural (that is, unplanned-for) transfer of knowledge, since employees from both firms work closely together. The joint venture form also provides a good mechanism for local SOEs to accumulate technological capability because much technical knowledge is of the "embedded" variety.

2.2.1.1 Technology and Learning

There are two complementary elements of technology: "public knowledge" and "embedded knowledge." At one end of a spectrum is public knowledge, that is, knowledge that can be accessed by the general public. On the other end is deeply-embedded knowledge, referred to as "tacit" knowledge, which may consist of routines and processes that often are proprietary and can be observed only by the owning firm.

"Technological capability" is itself an embedded, or tacit, knowledge (the second element of technology). Tacit capabilities are the result of internal learning processes; they are embedded within these processes (Cantwell, 1991; Cantwell & Barrera, 1998). Technological capability cannot be traded, it can only be imitated, "with or without assistance" from the originating firm (Cantwell, 1991). These skills, routines and processes are developed over time in a gradual process involving trial and error, and they are a primary source of competitive (or ownership, in the OLI paradigm) advantage (Dunning, 1993).

Tacit knowledge is difficult, time-consuming and expensive to transfer, and is more likely to be transferred internally (Sachwald, 1998). Kogut and Zander (1993) suggest that as complexity increases, so too does the probability that a MNC will transfer knowledge internally. Ultimately, this implies that the more complex (or the more "tacit") the technology to be transferred, the more likely it is to be transferred internally, rather than relying on market mechanisms.

Learning between firms is more likely to be useful if the two firms are more complementary in terms of technological specialization (Cantwell & Barrera, 1998).

Complementary technological capability is likely to be a key factor in joint venture partner selection. As Mowery et al. (1998) pointed out, "firms jointly pursuing collaborative development of a technology or product within an alliance are likely to require some level of technological 'overlap,' to facilitate know-how exchange and development." This technological similarity is an important consideration, potentially a condition for effective learning.

Another potential condition for effective learning to take place is that each partner's competence should come from a different set of resources. Sachwald (1998) supports this by stating that "cooperation is more likely when the required competences result from a very distinct set of resources" because integration "is costly, time-consuming and risky, so the firms may choose cooperation as a more efficient solution." In the case of the IJV, Chinese companies want to learn foreign technology while foreign firms want to acquire a deeper understanding of the local Chinese markets and the "guanxi" network/ distribution system (Luo, 2000).

However, the joint venture is not an alternative to in-house development (Cantwell & Barrera, 1998). "When joint venture (alliance) is used by one firm to internalize new technology-based capabilities from a partner, the demands of the technology absorption process are such that the 'student' must have considerable in-house technical expertise that complements the technology development activities of the IJV (alliance)" (Cohen and Levinthal, 1988, Mowery, Oxley, & Silverman, 1996). Learning can further organizational capabilities (Gulati, 1999). The IJVs are evolutionary and learning entities that have both the resources and incentive to encourage innovation and create new institutional arrangements, thereby acting to speed up evolution (Hedlund, 1986).

2.2.1.2 The Process of Technological Capability Building

Technological capability refers to the capacity of joint ventures to generate and manage technological change. This involves technology-changing skills -- a body of knowledge and experience that is often substantially different from what is needed to operate existing systems. Innovative IJVs are able to change or improve given technologies. Capability building reflects the extent to which an IJV commits to building new capabilities through learning from other organizations, creating new skills, or revitalizing existing skills in new situations (Luo, 2002). As international competition spreads, there is less opportunity derive profits from sheer market power -- the bargaining strength that allows firms to set higher prices in product markets, but to pay lower wages and lower prices to contractors. Positions of dominating market power are difficult to sustain and are being steadily eroded (Cantwell, 1991). The source of competitive advantage in today's markets is a firm's ability to generate and manage technological changes.

Technological capability is a cumulative process, due in part to the process of incremental learning and due also to the evolutionary process of developing locally-refined skills and routines. Technological change is incremental, in that it represents "the cumulative impact of small improvements" (Rosenberg, 1982). Routines only change slowly through careful experimentation, learning-by-doing and learning-by-using. The cumulative process also results from the need for critical revision, when one advance

gives rise to or inspires other advances in the same field of activity (Cantwell, 1991). The effective development of technology seems to depend less on linear logic than on identifying or imposing patterns and connections; experience with present products and processes often provides better guidance than scientific principles (Loasby,1998). New product and process developments are likely to lie in the technological neighborhood of previous successes (Teece, 1998).

The taxonomy of technological capabilities for the joint venture draws on the analytical framework proposed by Bell & Pavitt (1995), Lall (1992); and, in particular, for the manufacturing industry in developing countries, on the adaptations carried out by Ariffin (2002), Figueiredo (2003), Figueiredo (2001), Dutrénit et al (2003) and Dutrénit, Vera-Cruz & Arias (2004). The taxonomy is based on the evidence of the characteristics of the accumulation processes of technological capabilities in manufacturing joint ventures.

There are four levels of technological capabilities: one level of routine production technological capabilities, and three levels of innovative technological capabilities – basic, intermediate, and advanced.

Basic operative capability is the capability to produce goods at given levels of efficiency and given input requirements. It may be described as technology-using skills and knowledge.

Innovative technological capability is defined as the capability to change or improve products and processes. It may be described as change-generating capability or technology-changing skill (Bell & Pavitt, 1995).

At the **basic operative capability level,** the IJV has the ability to assimilate technology, and replicate the basic production methodologies. At the **basic innovative capability level,** the IJV has the ability to make incremental changes of process to improve quality. At the **intermediate innovative capability level,** the IJV has full production skills and the capability for process innovation and product design. At the **advanced innovative capability level,** the IJV conducts its own R&D for products and processes (linked to market needs), and can establish product innovation capabilities on its own.

The taxonomy distinguishes the technical functions in which technological capabilities are developed. There are three technical functions which apply to manufactures: (i) investment functions: including decision-making control, project preparation and implementation of large investment projects, or upgrading projects; (ii) production functions: referring to the generation and management of technical change in processes, products, and production organization; and (iii) supporting functions: consisting of the development of links and interactions for innovative activity.

Investment capabilities are the skills needed before a new facility is commissioned or an existing plant is expanded. They entail identifying needs; preparing to acquire and acquiring necessary technology; and designing, constructing, equipping and staffing the facility. They also entail determining the capital costs of the project, as well as the

appropriateness of the scale, product mix, technology, and equipment selected, and the understanding gained by the operating firm of the basic technologies involved (which, in turn, affects the efficiency with which it later operates the facility). The investment function in my study is not limited only to the hardware investment; it also includes upgrading software and information technologies. The use of information technology will lead to a larger number and variety of people participating as information sources in the making of decisions, while decreasing the number and variety of people engaged in traditional face-to-face interactions. Effective use of IT will also result in less organizational time being taken up by decision-related meetings.

Production capabilities range from basic skills like quality control, operation, and maintenance, to more advanced ones like adaptation, improvement, or equipment "stretching," to the most demanding ones of research, design, and innovation. These capabilities affect both process and product technologies. The skills involved determine not only how well given technologies are operated and improved, but also how effective are in-house efforts to absorb technologies imported or imitated from other firms.

Linkage capabilities are skills needed to transmit information, know-how and technology to, or receive them from, component and raw material suppliers, subcontractors, and customers. Such linkages affect not only the productive efficiency of the IJV (allowing it to specialize more fully), but also the infusion of technology throughout the economy -- thus deepening the industrial structure -- both of which are essential to industrial development. The significance of extra-market linkages in promoting increases in productivity is well recognized in the literature discussing developed countries.

To be successful, a business must provide value to its customers, be competitive and differentiated in the market, and possess core competencies. There are a number of alternative approaches for IJVs to consider when pursuing these goals.

Acquiring a thorough understanding of the market, assessing the needs of the market and developing an effective business plan to exploit this knowledge will significantly improve a firm’s likelihood of success. (This attention to the market, of course, was totally foreign to Chinese state-run businesses that were operating within a planned economy.) Assessing the needs of a defined market and filling a void in that market is also an effective way for IJVs to achieve sustainable competitive advantage. In this regard, rarely will it suffice merely to manufacture a technologically-innovative product. One must also develop capabilities to acquire resources to finance sustainable growth, to market the product effectively and to interact efficiently with distribution channels.

In the evolutionary view, technological knowledge is not an immediately usable product in its own right, but is rather a tool in the collective corporate learning process by which tacit capability, and hence technology, as a whole is generated. It is an input that normally is most relevant to the learning process of the joint venture that both created it and fixed the problem-solving agenda to which it represents a response. Thus, it is likely to be of the greatest value to the joint venture.

Table 2-1 presents the taxonomy of technological capabilities for the manufacturing industry. It illustrates each stage in the accumulation of each technical function, and lists the activities most characteristic of each level.

TABLE 2-1: Taxonomy of Technological Capabilities

Main Activities / **Capability Level**	**Investment functions**		**Production functions**		**Supporting functions**
	Decision making and control	*Project preparation and implementation*	*Organization of processes and production*	*Product centered*	*Developing linkages*
Basic Operative Capabilities	Engaging primary contractor and payment estimation	Preparation of initial project outline Construction of basic civil works	Routine operation of and basic maintenance, Efficiency improvement from experience in existing tasks.	Replication of product specifications and designs	Procurement of available inputs from existing suppliers. Sale of given products to existing and new customers
Basic Innovative Capabilities	Active monitoring and control of feasibility study, technology choice/sourcing and project scheduling	Project feasibility study, Standard equipment procurement and Simple ancillaries engineering	Improving layout, scheduling, maintenance and minor process adaptation	Minor adaptations to market needs, and incremental improvement in product quality	Searching and absorbing new information for suppliers, customers and local institutions
Intermediate Innovative Capabilities	Search, evaluation and selection of technology Sources, tenders negotiations and Overall project management	Detailed engineering Project scheduling and management Commissioning	Process improvement, licensing new technology Introducing production organizational changes	Licensing new product technology and/or Reverse engineering, incremental new product designs	Technology transfer to local suppliers to increase efficiency, quality for local supply
Advanced Innovative Capabilities	Developing new production systems and components Product innovation and related R&D	Basic process design and related R&D	Innovation in processes and related R&D	Design of basic characteristics for new products Product innovation and related R&D	Collaboration in technological development with suppliers, customers and partners

Source: Adopted from Bell & Pavitt (1995), Lall (1992).

Learning is a dynamic, mostly-incremental process that unfolds over time and builds upon both current and previous knowledge (Cohen & Levinthal, 1986). From the joint venture partner's perspective, learning can be take place in several ways. The joint

venture can learn about its partner, from its partner and with its partners (Doz & Hamele 1998, Inkpen, 2002).

The IJV enters into a social community of sorts, that has its own unique methods to foster cooperation and communication, methods that can be used internally to exchange tacit knowledge (Kogut & Zander 1993). One of the key aspects of an organizational boundary expansion is the firm's ability to coordinate and internally transfer tacit knowledge. Kogut & Zander (1993) and Grant (1996). Kogut and Zander (1993) postulated that the survival of the firm is not so much related to market failure or opportunism, as it is to the effectiveness of its technology exchanges. "What determines what the firm does, is not the failure of the market, but the firm's efficiency in this process (knowledge transfer) relative to other firms" (Kogut and Zander, 1993). That is to say, a firm's existence and effectiveness are dependent upon its ability to internally create and diffuse knowledge.

Accumulation of technology within the international network of an IJV is a path-dependent learning process. Effective learning is reflected by an enhancement of an organization's skills and capabilities. Determining which vertical and horizontal links will be allowed to exist within a global network (that is, defining the IJV's boundaries) is a critical supervisory function of MNC management. As this study confirms, alliances between IJVs and their foreign parents and affiliates have given local Chinese businesses opportunities for knowledge accumulation beyond their own internal resources.

This study aims to empirically investigate the relationship -- between technological capability building and integration mechanisms: integration with headquarters, integration with other subsidiaries, interdependence and autonomy. That is to say, the study examines the technological capability accumulation and the consequences of establishing a multiplicity of links with foreign parents and their subsidiaries.

2.2.3.1 Direct Integration Mechanisms with the MNC Headquarters

It is recognized that particular forms of organization influence the directions and rates of technological progress (Dosi, Giannetti, and Toninelli, 1992).

Direct integration mechanisms with the MNC headquarters consist of many forms of contact and communication between the managers of foreign subsidiaries and headquarters. Each particular mechanism shares a common goal of creating a mutual understanding between subsidiary and headquarters management regarding the interests of the overall corporation and the role of the subsidiary (O'Donnell, 2000). Winter (2003) suggests that firms tend to handle the innovation process in a systematic way and develop – largely through trial and error – "routines" that guide their actions. Importantly, these routines are learned over time and they are highly firm-specific. Each organization develops its own particular way of doing things. And this can often be a source of competitive advantage.

An IJV's relationship with Headquarters is one of the most important aspects of its integration into the global network. That relationship may determine the degree to which its managers will successfully adapt to the foreign partner's routine and acquire the

parent's best practices. Managing rapid growth presents a formidable challenge for IJV managers. Training and development programs sponsored by the foreign parent can ease this task.

Commonly, vertical integration of a joint venture subsidiary begins with the subsidiary's managers' participating in executive development programs, in which manager from headquarters and the subsidiary spend time together at Headquarters. A major challenge for the IJV is to bridge the cultural divide between different languages and traditions, which can undermine the process of information sharing. To avoid cultural misunderstandings, participants from the parent and subsidiary must spend time together, willing to learn and embracing their exposure to new ideas and customs (Rosen, 1999). One would expect then that technological innovation capability will be positively associated with the use of integration mechanisms by the MNC Headquarters.

Hypothesis 1: The level of technological innovation capability is positively associated with the extent of the integration mechanisms with MNC HQ.

2.2.3.2 Integration Mechanisms with MNC Affiliates

Intra organization networks shape innovation dynamics and diffusion rates. Bartlett and Ghoshal (1990) point out that "by creating flexible linkages that allow the efforts of multiple units to be combined, a company can create synergies that can significantly leverage its innovation process." Teece (1998) observes that different units "must be in close and continuous communication and engage in mutual adaptation if innovation… is to have a chance of succeeding." Clearly, there is broad consensus that it is critical for companies to create an environment that encourages information sharing across its organizational and geographic borders. The IJVs with technological capability are those best able to gather new information from its internal network, to get informal communications between managers from different international locations and to seek advice from managers of different international locations. Learning requires resources of various kinds, as well as skillful organization and management. It is not automatic, and the direction it takes depends on the decisions the joint ventures make. The resources can be hierarchical as well as lateral.

Forming a joint venture is an important strategic action and the aggregation of such joint ventures constitutes a network. Resources inhere not so much within the firm as in the inter- or intra-firm networks in which the firm is located. The network ties accumulated over time can facilitate information exchanges that enable joint ventures to learn about new technologies, products and processes, and to learn how to improve their decision-making and linkage with customers/suppliers.

Hypothesis 2: The level of technological innovation capability is positively associated with the extent of integration mechanisms with the MNC network.

2.2.3.3 International Interdependence

International interdependence refers to the condition in which one sub-unit of the MNC relies on another sub-unit's activities or input in order to perform its role effectively

(O'Donnell, 2000). The business activities of the IJVs may be connected to the activities of headquarters or other foreign subsidiaries, or the IJV may depend upon the effective functioning of headquarters or other foreign subsidiaries to keep performing its own tasks effectively.

In like fashion, the activities of headquarters or other foreign subsidiaries may influence the outcomes of the IJV, and the headquarters or foreign subsidiaries may depend upon the IJV to effectively perform their tasks.

Firms collaborate to reduce the cost, time or risk of accessing unfamiliar technologies or markets. The networks thus formed are the most appropriate to facilitate an IJV's capability building. A network is as much a process as a structure, which both constrains the IJVs, and in turn is shaped by IJVs. Therefore, the collaboration can be understood as an attempt to cope with the increasing complexity and inter-relatedness of different technologies and markets.

Collaboration enables IJVs to pool resources or expertise and to work together to gain market knowledge. International interdependence is, to a large extent, an interactive process and the result of joint venture choices and decisions; a process that needs to be harnessed and even directed. That cooperation across borders -- exemplifying international interdependence -- is what actualizes the powerful potential of this process to advance technological capability.

The largest, most technologically-savvy firms rely upon international networks for the accumulation of technological competencies that are dispersed both geographically and by business sector. However, the management of these networks remains a difficult and complex organizational task. For this reason, firms which have developed such networks have tended to target either a wider geographical dispersion of technological competence, or alternatively a wider dispersion of interrelated competencies by sector across technological fields that are more confined geographically.

Integration of the IJV into a developed economy should be seen as a comprehensive process, and it cannot be accomplished without cooperation and partnership. Technological know-how acquired through interactions with other countries may be the most important mechanism for IJVs from developing countries to become integrated into the international economy. The importance of strengthening the endogenous base of technological growth and development cannot be overemphasized.

This is easier said than done. In the first place, Chinese joint ventures need to become acclimatized to a culture of international cooperation. Moreover, foreign technological activity today often aims to tap into local fields of expertise -- expertise that domestic Chinese firms sometimes need to develop from scratch.

Increasingly multinational companies are committed to the development of international networks in order to exploit the potential of diverse geographically-scattered centers of competence. International interdependence is thus very much at work.

Hypothesis 3: The level of technological innovation capability is positively associated with the degree of international interdependence.

2.2.3.4 IJV Autonomy

IJV autonomy is defined as the degree to which the IJV "has strategic and operational decision making authority" (Hill & Hellriegel, 1994). Another definition was given by Björkman (2003), who defines subsidiary autonomy in the context of an MNC as the extent to which decision-making is taking place in the subsidiary without interference from the headquarters. To be autonomous, the subsidiary must have independence from the parent across all business activities.

The level of JV autonomy can differ significantly depending on the characteristics of the MNC and subsidiary, and environmental factors (Björkman 2003). The degree to which IJVs exercise control over their own affairs varies greatly. At one extreme are the IJVs that must refer to headquarters for virtually every decision. At the other extreme are strategically-independent IJVs that enjoy wide latitude to make their own decisions.

In examining whether autonomy is good for the subsidiary, empirical studies so far have produced conflicting results. On one hand, O'Donnell (2001) posits that the higher the degree of autonomy IJV managers have, the more flexibility they have in dealing with the challenges they encounter in their particular market and area of industrial specialization. To the same effect, Gifford found in his research that joint ventures in developing countries appear to respond more favorably when granted high levels of autonomy (Zeira, Gifford, 1998). Autonomy in implementing strategic business plans may be particularly important since implementation involves close interaction with the local community. As the Chinese business environment is quite different from the environments in the U.S. and Western Europe, adapting to local business customs could be even more important in the case of Sino-Western IJVs located in China (Newburry, W., Zeira, Y., Yeheskel, O.,2003).

On the other hand, Varblane et al. (2005) conclude that higher autonomy in marketing is negatively associated with technology upgrading, as measured by productivity levels, the improvement of production equipment, and the quality of finished products. This is consistent with Cohen and Levinthal (1990), who have suggested that an organization needs an extended period of time to develop accumulated absorptive capacity. This capacity allows the organization to recognize, assimilate and commercialize valuable knowledge. This capability can only be developed over time, is path-dependent and is crucial if the firm is to develop a competitive advantage.

This study postulates that IJVs need to maintain close connections with their MNC parents in order to successfully accumulate technological knowledge. Therefore in this study, I hypothesize that joint ventures can build their technological capability by learning from the headquarters, especially in decisions about changing to a new manufacturing process; and that they make better quality-control decisions when the

corporate partners have a higher level of control over local, on-site managers to make and implement decisions on critical business issues.

Hypothesis 4: The level of technological innovation capability is negatively associated with the degree of IJV autonomy.

3. Methodology

This section describes the data collection and sample analysis on which this study was based. In the data collection section, I discuss the questionnaire and how the data was collected. In the sample analysis section, I describe the sample joint ventures -- their age, size of investment, ownership, country of origin -- and analyze their learning speed.

Data Collection

This research sampled 51 international joint ventures in China through the submission of a detailed survey questionnaire. All of those surveyed were manufacturers who have operated in China for at least two years. They produce goods in industries such as food packaging, equipment fabrication, automobiles, process automation and telecommunication. Several of the joint ventures share common parents, either on the Chinese side or the foreign side.

One of the largest industry groups in South China supported this study. The group, which has since disbanded, had 572 members, of which 179 had formed joint ventures with foreign companies. Thirty-one of these IJVs (*i.e.*, 17.3%) responded to this survey. Four of them were dropped from this study because they did not supply sufficient data.
The survey was also distributed among the graduates of Rutgers EMBA program in China. Rutgers initiated an EMBA program in Beijing in 1998. The EMBA program was geared toward employees of high potential working at multinational corporations in China. Many of these graduates are now working in international joint ventures. The survey was sent to 100 Rutgers graduates, 27 of whom (27%) responded. 3 of them have too many missing data. Therefore they were dropped from the current study.

Conclusions

Within this manuscript, I have developed hypotheses predicting technological capability accumulation based upon a set of integration mechanisms. I will empirically test my hypotheses in the next stage of the study. Following is one case study to support my hypothesis in the study.

Case 1: Integration And Technological Capability Accumulation

Background

This joint venture between a large European company and East China Fabrication Plant, a state-owned enterprise, was established in 1995 upon a total investment of $80-million and registered capital of $30-million. The foreign partner owns 60% of the IJV's equity, and has contributed technology and cash to the venture. The Chinese partner holds a 40% equity interest, and has supplied land and equipment to the IJV.

The Chinese partner built the plant in the early 80s on a tract of suburban farmland. Local law had required that the plant employ at least 50% of the displaced farmers. The pre-IJV plan was to import equipment to manufacture products thought to have excellent market potential. The management team assumed that the imported equipment would enable the plant to manufacture high-quality products. This assumption proved incorrect. After several years and with the assistance of foreign experts, the plant was only able produce material of nine-micron (9u) thickness and inconsistent quality. The plant's output averaged around 500 tons per month (one-third of capacity). By the early 90s, management had learned that even the best equipment could not insulate the operation from all manufacturing problems. The company reached out for a foreign partner to furnish technological know-how and management expertise.

The company courted a foreign partner that wanted to “learn to grow” in China. That partner was attracted to this plant by its new, imported equipment (the best in China at the time), its excellent location, and by the promise of majority control. The joint venture was formed in 1995 after three years of negotiation.

The IJV hired eight expatriate employees, all upper-level management, to turn the operation around. This management group inherited 330 local employees ("unknowns" to the new managers). The Chinese employees were poorly trained and undereducated. There was little manufacturing expertise among them and even less marketing acumen.

During the IJV negotiation, a joint team representing the Chinese and foreign parties had performed a marketing feasibility study. This study revealed that there was a need in the marketplace for material gauged at seven microns (7u). And this gauge was nowhere produced in China at the time. Customs records indicated that material of this gauge was being imported into China. Based on this study, the parties agreed that the foreign partner would transfer technology to the IJV for the manufacture of 7u-gauged material.

Learning By Doing

In its first year the joint venture did not run as smoothly as was anticipated. The IJV was trying to replicate the product and processes of a sister plant overseas. The foreign partner sent 16 technicians to help with the technology transfer. They provided expertise in areas such as production, processing and equipment. Due to equipment differences, the IJV had to modify the production process. There was an extended period of trial and error. The scrap rate was very high. The product was bedeviled with quality problems, as customer complaints poured in. The feedback from the IJV's sales department was not

good; complaints of the “bad quality” of the products demoralized the production department. These problems posed monumental challenges for the sales and marketing departments. The Chinese Party weighed in, registering its disappointment that the expertise of the foreign partner had not brought the expected "breakthroughs” in innovation and production. The IJV was not realizing its significant potential for incremental innovation. At that time each innovation was perceived as a single isolated change rather than as part of a series of integrated events.

As the IJV failed to meet the performance goals set by the foreign parent, the parent's regional manager devoted more and more time applying pressure to the IJV's management team for a quick turn-around. During this process, the regional headquarters of the foreign parent replaced the top managers. The original IJV management team had thought technology transfer was just “blue print” transfer, not the gradual learning of locally-refined skills and routines. Nor had it realized that routines only change slowly through careful experimentation: learning by doing and learning by using. Often the IJV was able to find a quick-fix for one quality control problem, only to see others sprout up in its place.

Under new management the quality of the product was incrementally improved. The IJV learned that in order to maintain consistent quality, regular maintenance of the equipment was essential. Procedures for this were developed. Later on, with the help of the foreign experts, the IJV adapted its manufacturing processes around the condition of its equipment and the needs of the local market. An integrated quality management system was implemented. The IJV was ISO 9000 certified. Production schedules were established to meet the demands of customers. As the IJV modified its equipment and production processes to improve the quality of its product, more product variety was introduced. Now the IJV was able to achieve process innovation based on market demand and production requirements. Through continuous improvement, first with outside assistance and later with skills, routines and processes developed within itself through trial and error, the IJV became its own primary source of technological innovation. This innovation was its greatest competitive advantage.

Efforts To Integrate The IJV Into The Global Network

From the start of this project, the IJV's foreign parent invested tremendous efforts to integrate the IJV into its global network. Senior managers of the IJV were flown to the parent's headquarters to be trained in the values and business mission of the parent. Senior managers of the parent traveled to the IJV every few months, for visits of three days or longer. During these visits, issues relating to production, finances and human resources management were discussed. The IJV's management team gave presentations to the senior managers on the progress of each department: production, processing, purchasing, finance and sales. The senior managers offered advice and comments on key issues. Through these exchanges, the foreign parent came to understand the operational issues of the IJV. And the IJV managers began to understand the management philosophy of the foreign parent.

In the meantime the IJV built strong ties with another subsidiary of the foreign parent, a company the IJV came to regard as its "sister." The sister plant transferred technology and a management system to the IJV. During the first year of the IJV, 30 of its employees (equipment operators and workshop maintenance crews) were dispatched to the sister plant for a three-month training program. During this period, the operators worked side-by-side with their counterparts from the sister plant to observe how that plant operated. The training was hands-on: the operators were instructed how to run the equipment, and actually manufactured product for sale. This created an environment in which technology was freely shared across organizational and geographic borders.

Because the product mix of the IJV was different than that of its sister plant, the parent introduced the IJV to other affiliated plants that could provide technological assistance with other products. Operators from the IJV were dispatched to those plants to learn their manufacturing processes. In this way, the IJV was able to gather new information about a wide range of products from an international network of affiliates. This intra-organizational network shaped he IJV's innovation dynamics and diffusion rates.

So long as the IJV was dependent upon the training and technical assistance of its foreign affiliates, the business of the IJV was limited to what the IJV could copy from those affiliates. But this would change as the IJV developed its own technological capability.

The IJV fulfilled its technology requirements, developing viable products in 6.5u and 7u gauges. Within four years, the IJV doubled the volume of its average shipment; within nine years, that volume had tripled. The IJV developed the capacity to do business in English and Chinese. It moved from a “produce for inventory” model to a “produce for order” model. Eventually the IJV was able to manufacture product to a higher standard than the IJV contract called for. The decision to raise its standards was dictated by changes in its local market, to which the IJV was able to adapt on its own. And the IJV was able to accomplish all this while remaining faithful to the values and policies of its foreign parent.

Four years after the formation of the IJV, the foreign parent acquired two other plants in China that produced similar products. This time the IJV served as the source of technical and manufacturing support for its sister affiliates. With that technical support, including assistance in matters of safety, health and environmental protection, the other two ventures launched successfully.

Conclusion

This IJV evolved from a mere receiver of others' technology into a highly competent innovator of its own technology. It emerged as a firm that offered value-added services that were leveraged throughout its parent's global network. It stands as an example of how the international joint venture can successfully integrate technological capability not merely to copy, but also to advance the technological capabilities of its peer affiliates.

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